CONDUMAX

ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT NAME:	SITE:
Cable A: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X35+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION Cable B: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X95+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION	Brazil, Olímpia – SP

in accordance with ISO 14025 and EN 50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	EPD008
Registration Number	EPDITALY0885

Issue Date	29/01/2025
Valid to	29/01/2030

Cable A and Cable B

GENERAL INFORMATION

EPD OWNER

Name of the company	Condumax – Eletro Metalurgica Ciafundi LTDA
Registered office	Rodovia Wilquem Manoel Neves, s/n km 3,5, Olímpia – SP, Brazil, 15405-370
Contacts for information on the EPD	Robson Micheletto Quality and Environment Manager robson.micheletto@condumax.com.br

PROGRAM OPERATOR

EPDItaly	Via Gaetano De Castillia, 10 20124 – Milano Italy

INFORMATION ON THE EPD

Product name (s)	Electrical wires and cables: Cable A: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X35+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION Cable B: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X95+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION
Site (s)	Rodovia Wilquem Manoel Neves, s/n km 3,5, Olímpia – SP, Brazil, 15405-370
Short description and technical information of product (s)	Cable A and B: Conductors: PHASE(S): ALUMINUM WIRES ALLOY 1350, TEMPER H19, STRANDING CLASS 2, COMPACTED. NEUTRAL: ALUMINUM WIRES ALLOY 6201, STRANDING CLASS 2, NOT COMPACTED. Insulation: PHASE(S) AND NEUTRAL: XLPE - THERMOSET COMPOUND OF CROSS-LINKED POLYETHYLENE.
Field of application of the product(s)	Used in the public secondary distribution network of low voltage energy, urban or rural, aiming at greater safety, reliability and less aggressive visual effect. They are also suitable for use in wooded areas.
Product reference standard(s)	Cable 7 and 8: GSCC-009 R-02, 12/2022. GLOBAL STANDARD - LV AERIAL BUNDLED CABLES NBR 8182:2011 - SELF-SUPPORTED POWER CABLES, PE OR XLPE INSULATED, FOR RATED VOLTAGES UP TO 0.6/1 kV. – PERFORMANCE REQUIREMENTS
CPC Code	463 family “Insulated wire and cable; optical fibre cables” and sub-sequent clusters

VERIFICATION INFORMATION

Product category rules (PCR): (title, version, date of publication or update)	Core PCR EPDItaly007 - PCR for electronic and electrical product and systems. Revision 3.1 – 2024/11/12; Conducted by ICMQ S.p.A. – Certificazioni e controlli per le costruzioni Moderator: Eng. Vito D'Incognito, Take Care International Sub PCR EPDItaly016 - PCR for electronic and electrical product and systems – cables and wires. Revision 2 – 25/09/2020; Conducted by Enel S.p.A.; Life Cycle Engineering - Viale Regina Margherita 125 - 00198 Rome, Italy
EPDItaly Regulations (version, date of publication or update)	Regulation of the EPDItaly Program – rev.6.0 (2023/10/30)
Project Report LCA	Life Cycle Assessment (LCA) Report – LCA 12 cables_EPD 4-11_Condumax _ Rev 1_Nov 29, 2024
Independent Verification Statement	This declaration has been developed in accordance with the EPDItaly Regulations; further information and the Regulations themselves are available on the website: www.epditaly.it The PCR review was performed by ICMQ S.p.A. (PCR EPDItaly007) and Enel S.p.A (PCR EPDItaly016) - info@epditaly.it EN 50693 is the framework reference for PCRs. Independent verification of the declaration and data according to ISO 14025:2010. Internal ☐ External ☒ Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability	Environmental statements published within the same product category, but from different programs, may not be comparable. EPDs of Electrical wires and cables may not be comparable if they do not comply with EN 50693. For further information about comparability, see EN 50693 and ISO 14025.
Liability Statement	The EPD owner has the sole ownership, liability, and responsibility for the EPD. The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

Company information

Founded in 1964, Condumax is an electrical wire and cable supplier to the main energy concessionaires in Brazil and abroad. The company is located in São Paulo, Brazil, with more than 700 employees and more than 1000 indirect employees. All Condumax cables are environmentally friendly, heavy metal free and meet international RoHs directives.

The ISO 9001, IATF 16949, ISO 14001 and ISO 45001 standards certify Condumax manufacturing unit. Some of Condumax cables and wires also are Environmental Product Declaration certified according to ISO 14025. While the International Standard Industrial Classification of All (ISIC) classifies the factory as Division 27, Group 273 and Class 2732. The ABNT also granted the license for using the ABNT Environmental Mark – ABNT Ecolabel, meeting the requirements of the document PE-425, ISO 14020 and ISO 14024.

EPD Information:

Scope of EPD:

The EDP aims to communicate the impact of the cables to its customer, being a B2B communication. The Condumax customer seeks to reduce the environmental impact of its value chain and, for that, has implemented a sustainability management policy (Sustainable Purchases), starting to request actions to quantify and mitigate environmental impacts of its suppliers, such as Condumax.

Type of EPD:

This declaration is specific for electrical wires and cables.

Declared unit:

To transmit energy expressed for 1A over a distance of 1 km (cable length) for 40 years (RSL) and 100% of use rate.
For the cable A, 1 km (cable length) is equal to 590.89 kg; for the cable B, 1 km (cable length) is equal to 1172.90 kg.

Reference flow:

The reference flow of the cable A, LV AERIAL BUNDLED CABLES 0,6/1 kV 3X35+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION, is 590.89kg.
The reference flow of the cable B, LV AERIAL BUNDLED CABLES 0,6/1 kV 3X95+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION, is 1172.90 kg.

Data:

Condumax has provided all information for the study execution, so it has described all the raw materials used, the acquisition method, product characteristics, production stages, waste generated and all other information for the impact's calculation.
Condumax team of experts manages the production of the cables in its factory, being possible to obtain the total quantity of the cable manufactured in 2023. The data about the cables technical specifications (or the "product structure" that contains all the information about the quantity of raw materials consumed per meter of cable produced), was obtained through the product cost sector, with the support of the engineering team that is responsible for maintaining these cables technical specifications data sheet updated. That updated cables technical specifications data sheet was used as the cable study data sheet, and given this two information (quantity production and product structure) it was possible to calculate the raw material consumption of Condumax production in 2023.
The company has its own greenhouse gas (GHG) emission management data collection standard.

Time representativeness:

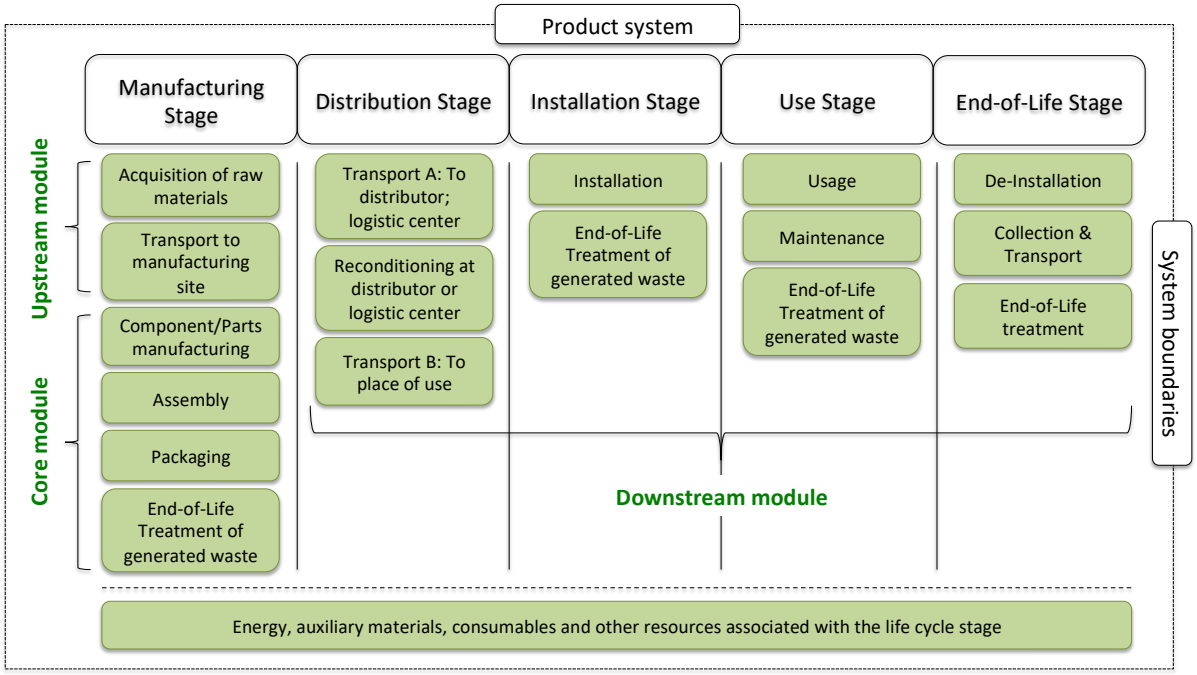
January 2023 to December 2023.

Database and LCA software used:

The source inventory and the emission factors of inputs and outputs used in the study are from the EN 15804 add-on for ecoinvent version 3.8 database, calculated using the OpenLCA software v. 2.2.

Description of system boundaries:

Cradle to grave: All stages until the end of life.



Source: Adapted from EN 50693:2019

Upstream module:

Manufacturing stage: The upstream module of the manufacturing stage considers all upstream processes to extract and process all the raw materials used by Condumax to manufacturing its products, including electricity consumption and other. This stage also accounts the emissions for the road and maritime transportation of all materials and components from suppliers to Condumax plant.

Core module:

Manufacturing stage: The core module of the manufacturing stage includes all the material transformation, assembling and packing for the cables manufacturing process; the water, gas and electricity consumptions; and the residues and effluent treatment, considering also the recycling processes of the metal end plastics scrapes generates during the manufacturing process. The processes stages to manufacturing the cables are as follow.

- Drawing – The drawing process is used to reduce the cross-section (area) of the filament and change the material's mechanical properties.
- Twist – This process aims the filaments to twist, transforming them into ropes and giving the cable certain flexibility.
- Taping – This process bandages the material using a tape. At Condumax, they can wrap study cables in aluminum or polymeric tape, to protect against electromagnetic interference.

- Extrusion - It comprises the process of the polymeric material covering the entire product surface. At Condumax, they intend the polymeric extrusion for electrical insulation.
- Measurement and packing – The measurement and packaging sector aims to ensure that products are measured, fractionated, packaged and identified in the characteristics expected by customers. They can package the products in coils, plastic spools, rolls or cardboard boxes.

Downstream module:

Distribution: The cables are transported from Condumax's factory to the client warehouse, place where the cables is stored until be sent to the installation. As the cables can be transported from São Paulo to any Brazilian state, an overland distribution scenario of 1000 km is adopted.

Installation: It was considered that the installation process generates 5% of the cable total mass and the package as waste, that is transported to its final destinations (200 km distance). The cable waste is sent for recycling, and the packaging is reused and used in handmade products.

Use: During the use stage, the cable dissipates energy due to the Joule effect. The dissipation energy calculation followed the Sub PCR EPDItaly016, considering a current of 1A during a lifetime of 40 years. The equation is presented below:

$$E_{use}\ [\frac{J}{km * A^2}] = R_{linear} * I^2 * RSL$$

Where:
E_{use} is the energy dissipated by the cable during its operating time
R_{linear} is the linear resistivity of the cable, expressed in Ω/km
I is the current, expressed in A
RSL is the reference service life of the product in second.

End-of-life: The stage considers the transport of the cable de-installed to the client warehouse (250 km distance); the cable disassembly operations, that consider the separation of the cable metal and plastic materials; the transportation of the residues from the warehouse to its disposal site (200 km) and, finally, the recycling processes of the EoL product's metal and plastic.

Allocation:

- The cable and packaging materials mass are in accordance with the structure file provided by Condumax.
- To emission of the raw materials transport, from the supplier to Condumax, it was considered the materials consumed for the cables manufacturing. That includes the material allocated in the cables and its proportional waste generated during manufacturing process.
- The scraps allocation of aluminum and copper was calculated according to the relative metal mass consumed in the product manufacture.
- It was considered mass allocation to obtain the electricity, water and LPG consumption of the manufactured cable, and also the allocation of the mass of miscellaneous waste disposal. This means that it was considered the proportion

of cable-produced mass in front of the mass of all cables produced in the evaluated time of the study to obtain the mass of the utility and waste allocated for each cable.

- The discarded aqueous emulsion mass per cable was also calculated proportionally mass of the cable, but had considered only the fraction of the metal mass consumed to produce the cables.
- The discarded production scraps and various contaminated residues mass was calculated proportionally to the mass of the cable, considering the fraction of the metal and polymers mass.

Cut-off criteria:

The cut-off criteria are applied to support an efficient calculation procedure. Following the EPDItaly 016, it was considered the following operations in the cut-off criteria:

- The cable installation and de-installation operations were disregarded, since it was assumed that these operations are performed using manual tools (chapter 4.2.3.9);
- Maintenance operation was disregarded, since it was considered no scheduled interventions during the life of the product (chapter 4.2.3.5);

Additional information:

- During the manufacturing stage, the waste is generated during the production process and packaging (waste from raw materials), and contaminated residues and aqueous emulsion generated from production process and machine operation.
- The production and packaging generated waste are inert and sent to recycling, the contaminated residues are sent to incineration, and the aqueous emulsion is sent to effluent treatment process.
- In order to calculate the allocations based on the cable produced mass (e.g.: Energy, LPG, waste and etc.), it was considered the proportion of the produced cable mass in comparison with all raw materials used for all the cables manufactured in Condumax in the period of the inventory analysis, even if the raw materials are not used for the cables production analyzed in this report.
- Condumax customer and Condumax plant confirm that all material used in the finished product (installation waste, packaging and EoL product) are sent to recycling. The polyethylene, even if a percentage goes to the landfill, it is recovered and sold by collectors and reused, turning into sustainable products, a common practice in Brazil.
- In Brazil, commercial diesel has a 12 % biodiesel fraction (biodiesel minimum percentage added to commercial diesel).
- Electricity used to manufacture the product comes from the Brazilian Electricity Matrix.
- It was considered the Condumax technical specifications of the cable structure to obtain the life cycle inventory (LCI) of the raw material emission source. e.g.: 0.1 of aluminum to 1 meter of cable.

Detailed product description

Following ABNT ISO 14025 and EN 50693:2019, the study presents the environmental declaration of two cables produced by Condumax to meet its necessity in front of its customers.

Analyzed cable A: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X35+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION:

The cable detail is presented as following:

Conductors:
PHASE(S): ALUMINUM WIRES ALLOY 1350, TEMPER H19, STRANDING CLASS 2, COMPACTED.
NEUTRAL: ALUMINUM WIRES ALLOY 6201, STRANDING CLASS 2, NOT COMPACTED.
Insulation:
PHASE(S) AND NEUTRAL: XLPE - THERMOSET COMPOUND OF CROSS-LINKED POLYETHYLENE.
Standard: GSCC-009 R-02, 12/2022. GLOBAL STANDARD - LV AERIAL BUNDLED CABLES and NBR 8182:2011 - SELF-SUPPORTED POWER CABLES, PE OR XLPE INSULATED, FOR RATED VOLTAGES UP TO 0.6/1 kV. – PERFORMANCE REQUIREMENTS

Main raw materials:

In 2023, January to December interval, Condumax has manufactured 23.66 km of finished product. Its mass composition is as followed:

Product Components	Weight (kg per km)	%
Conductor	421.24	71.29
Insulation	169.65	28.71
Total	**590.89**	**100**

The cable is packaged on a wooden reel.

Environmental performance

Besides the total results, parameters are declared separately for stage.

Environmental impact descriptive parameters

Impact category	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
GWP-total	kg CO_2 eq.	2.83E+03	1.41E+02	9.70E+01	2.10E+02	1.01E+02	5.58E+02	3.94E+03
GWP-fossil	kg CO_2 eq.	2.80E+03	8.16E+01	8.76E+01	5.90E+00	5.56E+01	5.54E+02	3.59E+03
GWP-biogen.	kg CO_2 eq.	-2.03E+02	5.43E+01	2.46E+00	2.03E+02	4.08E+01	1.97E+00	9.95E+01
GWP-luluc	kg CO_2 eq.	2.31E+02	5.58E+00	6.88E+00	4.64E-01	4.09E+00	2.24E+00	2.50E+02
AP	mol H^+ eq.	1.94E+01	2.06E-01	4.28E-01	2.88E-02	1.38E-01	7.02E-01	2.09E+01
EP freshwater	kg P eq.	4.09E-01	2.43E-03	9.34E-03	6.29E-04	1.40E-03	4.88E-02	4.71E-01
EP marine	kg N eq.	2.14E+00	6.80E-02	1.91E-01	1.29E-02	4.48E-02	1.96E-01	2.65E+00
EP terrestrial	mol N eq.	2.17E+01	7.05E-01	1.73E+00	1.16E-01	4.69E-01	1.84E+00	2.65E+01
POCP	kg NMVOC eq.	7.30E+00	1.69E-01	5.33E-01	3.59E-02	1.08E-01	5.06E-01	8.65E+00
ODP	kg CFC-11 eq.	3.63E-04	1.32E-05	8.45E-06	5.69E-07	9.55E-06	1.35E-05	4.09E-04
ADPN	kg Sb eq.	8.23E-03	2.03E-05	2.24E-04	1.51E-05	9.72E-06	3.52E-04	8.85E-03
ADPF	MJ	3.78E+03	1.86E+01	1.44E+02	9.71E+00	5.42E+00	9.75E+02	4.94E+03
WDP	m^3 eq.	9.84E+03	2.39E+02	1.32E+01	8.89E-01	1.81E+02	5.37E+02	1.08E+04

GWP-total: Climate change - total; **GWP-fossil**: Climate change - fossil; **GWP-biogen.**: Climate change - biogenic; **GWP-luluc**: Climate change – land use and land use change; **AP**: Acidification; **EP freshwater**: Eutrophication aquatic freshwater; **EP marine**: Eutrophication aquatic marine; **EP terrestrial**: Eutrophication terrestrial; **POCP**: Photochemical ozone formation; **ODP**: Ozone depletion; **ADPN**: Depletion of abiotic resources – minerals and metals; **ADPF**: Depletion of abiotic resources – fossil fuels; **WDP**: Water use.

Parameters describing resource use

Renewable resource	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
PERE	MJ	3.05E+04	7.01E+02	1.39E+01	9.36E-01	5.31E+02	1.25E+02	3.19E+04
PERM	MJ	9.43E+03	9.09E+01	7.93E+01	5.34E+00	6.72E+01	4.54E+01	9.72E+03
PERT	MJ	4.00E+04	7.92E+02	9.32E+01	6.28E+00	5.99E+02	1.70E+02	4.16E+04

PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; **PERM**: Use of renewable primary energy resources used as raw material; **PERT**: Total use of renewable primary energy resources.

Non-renewable resource	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
PENRE	MJ	4.54E+03	5.77E+02	1.45E+02	9.73E+00	4.29E+02	1.17E+03	6.87E+03
PENRM	MJ	3.09E+04	1.34E+03	1.19E+03	8.02E+01	9.47E+02	9.66E+02	3.54E+04
PENRT	MJ	3.55E+04	1.92E+03	1.39E+03	9.34E+01	1.38E+03	2.15E+03	4.24E+04

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; **PENRM**: Use of non-renewable primary energy resources used as raw material; **PENRT**: Total use of non-renewable primary energy resources.

Water and secondary raw	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
FW	m^3	2.29E+02	6.06E+00	3.48E-01	2.34E-02	4.21E+00	1.25E+01	2.53E+02
MS	kg	0.00E+00	1.53E+01	1.50E+00	1.01E-01	1.15E+01	4.66E+00	3.31E+01
RSF	MJ	3.94E+00	2.23E-02	1.62E-01	1.09E-02	7.09E-03	1.68E+00	5.82E+00
NRSF	MJ	7.55E+00	4.94E-02	2.75E-01	1.85E-02	1.63E-02	2.32E+00	1.02E+01

FW: Net use of freshwater; **MS**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels.

Waste production descriptive parameters

Impact category	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
HWD	kg	1.64E+00	4.66E-03	3.37E-02	2.27E-03	1.69E-03	2.64E-01	1.95E+00
NHWD	kg	1.30E+02	5.20E+00	1.33E+02	8.97E+00	6.35E-01	5.87E+02	8.65E+02
RWD	kg	4.70E-01	3.45E-01	6.02E-03	4.05E-04	2.62E-01	1.22E-01	1.21E+00
MER	kg	2.43E+00	6.04E-02	4.27E-01	2.87E-02	1.65E-02	1.77E-01	3.14E+00
MFR	kg	3.42E+01	1.11E+01	7.84E-01	5.28E-02	8.35E+00	3.29E+00	4.15E+01
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed; **MER**: Materials for energy recovery; **MFR**: Materials for recycling; **CRU**: Components for reuse; **ETE**: Exported thermal energy; **EEE**: Exported electricity energy.

Analyzed cable B: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X95+54,6 MM2 ALUMINIUM CONDUCTOR XLPE INSULATION:

The cable detail is presented as following:

Conductors:

PHASE(S): ALUMINUM WIRES ALLOY 1350, TEMPER H19, STRANDING CLASS 2, COMPACTED.

NEUTRAL: ALUMINUM WIRES ALLOY 6201, STRANDING CLASS 2, NOT COMPACTED.

Insulation:

PHASE(S) AND NEUTRAL: XLPE - THERMOSET COMPOUND OF CROSS-LINKED POLYETHYLENE.

Standard: GSCC-009 R-02, 12/2022. GLOBAL STANDARD - LV AERIAL BUNDLED CABLES AND NBR 8182:2011 - SELF-SUPPORTED POWER CABLES, PE OR XLPE INSULATED, FOR RATED VOLTAGES UP TO 0.6/1 kV. – PERFORMANCE REQUIREMENTS

Main raw materials:

In 2023, January to December interval, Condumax has manufactured 14.04 km of finished product. Its mass composition is as followed:

Product Components	Weight (kg per km)	%
Conductor	879.90	75.02
Insulation	293.0	24.98
Total	**1172.90**	**100**

The cable is packaged on a wooden reel.

Environmental performance

Besides the total results, parameters are declared separately for stage.

Environmental impact descriptive parameters

Impact category	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
GWP-total	kg CO_2 eq.	6.00E+03	2.80E+02	1.76E+02	1.82E+02	3.71E+01	1.11E+03	7.79E+03
GWP-fossil	kg CO_2 eq.	5.70E+03	1.61E+02	1.59E+02	8.76E+00	2.05E+01	1.10E+03	7.15E+03
GWP-biogen.	kg CO_2 eq.	-1.73E+02	1.08E+02	4.47E+00	1.73E+02	1.50E+01	3.91E+00	1.31E+02
GWP-luluc	kg CO_2 eq.	4.80E+02	1.10E+01	1.25E+01	6.88E-01	1.51E+00	4.45E+00	5.11E+02
AP	mol H^+ eq.	3.98E+01	4.05E-01	7.77E-01	4.28E-02	5.10E-02	1.39E+00	4.25E+01
EP freshwater	kg P eq.	8.30E-01	4.74E-03	1.70E-02	9.33E-04	5.16E-04	9.68E-02	9.50E-01
EP marine	kg N eq.	4.32E+00	1.33E-01	3.47E-01	1.91E-02	1.65E-02	3.88E-01	5.23E+00
EP terrestrial	mol N eq.	4.38E+01	1.38E+00	3.14E+00	1.73E-01	1.73E-01	3.66E+00	5.23E+01
POCP	kg NMVOC eq.	1.47E+01	3.30E-01	9.68E-01	5.33E-02	3.97E-02	1.00E+00	1.71E+01
ODP	kg CFC-11 eq.	7.08E-04	2.62E-05	1.54E-05	8.45E-07	3.52E-06	2.68E-05	7.80E-04
ADPN	kg Sb eq.	1.64E-02	3.81E-05	4.07E-04	2.24E-05	3.58E-06	6.98E-04	1.75E-02
ADPF	MJ	7.33E+03	3.56E+01	2.62E+02	1.44E+01	2.00E+00	1.94E+03	9.58E+03
WDP	m^3 eq.	2.04E+04	4.74E+02	2.40E+01	1.32E+00	6.67E+01	1.07E+03	2.21E+04

GWP-total: Climate change - total; **GWP-fossil**: Climate change - fossil; **GWP-biogen.**: Climate change - biogenic; **GWP-luluc**: Climate change – land use and land use change; **AP**: Acidification; **EP freshwater**: Eutrophication aquatic freshwater; **EP marine**: Eutrophication aquatic marine; **EP terrestrial**: Eutrophication terrestrial; **POCP**: Photochemical ozone formation; **ODP**: Ozone depletion; **ADPN**: Depletion of abiotic resources – minerals and metals; **ADPF**: Depletion of abiotic resources – fossil fuels; **WDP**: Water use.

Parameters describing resource use

Renewable resource	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
PERE	MJ	6.37E+04	1.39E+03	2.53E+01	1.39E+00	1.96E+02	2.48E+02	6.56E+04
PERM	MJ	1.40E+04	1.80E+02	1.44E+02	7.93E+00	2.48E+01	9.00E+01	1.44E+04
PERT	MJ	7.77E+04	1.57E+03	1.69E+02	9.32E+00	2.21E+02	3.38E+02	8.00E+04

PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; **PERM**: Use of renewable primary energy resources used as raw material; **PERT**: Total use of renewable primary energy resources.

Non-renewable resource	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
PENRE	MJ	8.76E+03	1.14E+03	2.63E+02	1.44E+01	1.58E+02	2.33E+03	1.27E+04
PENRM	MJ	6.04E+04	2.65E+03	2.16E+03	1.19E+02	3.49E+02	1.92E+03	6.76E+04
PENRT	MJ	6.92E+04	3.80E+03	2.52E+03	1.39E+02	5.08E+02	4.27E+03	8.04E+04

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; **PENRM**: Use of non-renewable primary energy resources used as raw material; **PENRT**: Total use of non-renewable primary energy resources.

Water and secondary raw	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
FW	m^3	4.76E+02	1.20E+01	6.32E-01	3.48E-02	1.55E+00	2.49E+01	5.15E+02
MS	kg	0.00E+00	3.04E+01	2.73E+00	1.50E-01	4.26E+00	9.25E+00	4.68E+01
RSF	MJ	7.98E+00	4.26E-02	2.95E-01	1.62E-02	2.61E-03	3.33E+00	1.17E+01
NRSF	MJ	1.49E+01	9.54E-02	5.00E-01	2.75E-02	5.99E-03	4.60E+00	2.01E+01

FW: Net use of freshwater; **MS**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels.

Waste production descriptive parameters

Impact category	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
HWD	kg	3.32E+00	8.93E-03	6.12E-02	3.36E-03	6.23E-04	5.23E-01	3.91E+00
NHWD	kg	2.53E+02	9.01E+00	2.42E+02	1.33E+01	2.34E-01	1.17E+03	1.68E+03
RWD	kg	9.57E-01	6.85E-01	1.09E-02	6.01E-04	9.66E-02	2.43E-01	1.99E+00
MER	kg	4.78E+00	1.16E-01	7.75E-01	4.26E-02	6.08E-03	3.51E-01	6.07E+00
MFR	kg	7.08E+01	2.20E+01	1.42E+00	7.84E-02	3.08E+00	6.53E+00	6.87E+01
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed; **MER**: Materials for energy recovery; **MFR**: Materials for recycling; **CRU**: Components for reuse; **ETE**: Exported thermal energy; **EEE**: Exported electricity energy.

Both cables present similar structure, being the cable 8 heavier, and then with higher impact values, in comparison with the cable 7. Despite of that, due to its similar structure, and then similarity of the magnitude variation of the impacts along the life cycle phases, it is possible to make a unique analysis for both cables. For different impact categories, the manufacturing stage is the most relevant stage for different impact categories due to the aluminum acquisition, followed by the EoL that has its significance mainly due to the cable dissemble process and the final aluminum treatment for recycling. Furthermore, for the most of the impact categories, the distribution of the cable from factory to warehouse was more significant than the use stage due to the distance used that had considered the Brazilian geographical dimensions, while the use phase considers the energy dissipation due 1A current during 40 years of life time, what is directly proportionally to the electrical resistance value (Ω/km) of the cable. Finally, the installation stage was the less relevant for almost all impacts categories due to the study boundaries that consider the transport of the generated waste to the final collection site.

Additional information

From the data provided by Condumax, it was possible to build a model to calculate the EPD impacts categories of the life cycle assessment for each selected cable, being also possible to analyze the results in order to allow actions to compensate and improve the impact categories and to improve the environmental performance of the products and meet the demand of Condumax customers.

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